7. Abstract of work completed during the quarter

Task 1b: Build Preliminary Models on Existing Data – Progress on this task continues. We created a master dataset of several years of the British Columbia I/M program emissions and repair data. An initial analysis of the data was performed to make an association between before-repair emissions and the type of repairs that were made by mechanics. By comparing the before-repair emissions of a set of vehicles getting an EGR repair and another repair with a set of vehicles getting the same other repair (but no EGR repair), we found that the average EGR repairs were more likely to be made when the before-repair NOx emissions were much higher than average, CO emissions were much lower than average, and HC emissions were about average. This trend was observed to be true regardless of what the other type of repair was.

We performed regressions of the before-repair emissions as a function of repair types. This revealed that EGR repairs and catalyst repairs were associated with the largest emissions differences among the different sets of vehicles with different repair types. These regressions, however, did not include the expected problem-free emissions of the vehicles in the dataset, which would be important input values to final models.

For the project to be successful, it will be important to distinguish between malfunctioning EGR systems and malfunctioning catalyst; both can contribute to elevated NOx emissions. One of the problems in associating solely the before-repair emissions with catalyst repairs made to vehicles is that replacement of catalysts may be a common "fix" for a malfunctioning EGR system. This "problem" caused us to develop a different approach to the analysis of the data.

The new approach will be to develop expected emissions values for problem-free vehicles; expected HC, CO, and NOx emissions changes (that is, from before-repair to after-repair) associated with different repair types for different vehicle technologies; and models that predict the probabilities that an EGR system is malfunctioning. These models will be based on the measured HC, CO, and NOx emissions of the vehicle, the expected problem-free emissions of the vehicle, and the known emissions-changing characteristics of repairs.

We have used the British Columbia data to develop a technique for looking up the problem-free emissions of individual vehicles. However, since passing vehicles in British Columbia receive a fast pass, not a full ASM test, the problem-free values based on British Columbia data may be biased.

Accordingly, we have obtained California I/M program full ASM test data. Using full ASM test observations of vehicles that passed the California ASM test, we will develop a look-up table of the median problem-free emissions values for individual vehicles. The look-ups will be made on combinations of make, model, engine, emission control system technology, and odometer.

We also obtained California second-by-second ASM data from their roadside test programs. This data will be used to estimate the bias between fast pass ASM measurements and full ASM measurements and to develop models to predict full ASM test results from fast pass ASM test results. Having this capability is needed to confirm that the problem-free emissions values based on the California data are consistent with those for the British Columbia fleet. The full-ASM-prediction capability will also be beneficial for predicting the full ASM test emissions of individual vehicles in the Texas I/M program environment.